

**AIR QUALITY MANAGEMENT POLICY FOR DAIRY OPERATIONS**

**PILOT RESEARCH PROJECT**

**FINAL REPORT**

**December 19, 2011**



**Prepared by**

A handwritten signature in blue ink that reads "Gary W. Pruitt".

**Gary W. Pruitt  
Air Pollution Control Officer**

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## **I. EXECUTIVE SUMMARY**

This report describes a pilot research project designed and conducted to test the feasibility of a policy intended to provide guidance and establish requirements for effective prevention of air emissions from dairy operations located in the jurisdiction of the Yakima Regional Clean Air Agency (YRCAA). This project represents a successful partnership of participating dairies, YRCAA and environmental scientists. Input from all partners provided a wealth of information which helped determine which Best Management Practices (BMPs) best mitigate eight air pollutants, and which are most technically and economically feasible to implement. The BMPs were identified as pollutant-specific and system-specific, to be implemented according to flexible, site-specific, air quality management plans.

The policy tested by this project applies only to dairy operations at which cows are raised, kept and milked and at which the potential for significant emissions of air pollutants exists. 100% mitigation of any air pollutant was not expected. The policy and all BMPs contained in the policy were selected because they have been proven to be effective and found to be economically and technically feasible. A copy of the draft policy can be viewed at:

[http://www.yakimacleanair.org/PDFs/Dairy/Final%20Pilot%20Project%20clean%20copy\\_10Feb11.pdf](http://www.yakimacleanair.org/PDFs/Dairy/Final%20Pilot%20Project%20clean%20copy_10Feb11.pdf)

The policy tested by this project is not intended for any dairy operation located outside the jurisdiction of YRCAA. YRCAA jurisdiction is all lands inside Yakima County, excluding those lands within the exterior boundaries of the Yakama Indian Reservation. However, YRCAA authorizes any jurisdiction which has an interest in air emissions from dairies to use the policy or any document associated with the policy.

## **II. BACKGROUND**

On July 8, 2010 the YRCAA Board of Directors asked staff to address air emissions from dairy operations due to increasing citizen concerns. YRCAA staff proposed a policy-making process aimed at identifying and implementing BMPs at dairy operations in its jurisdiction. The Board approved the process and a workgroup was formed under the direction of YRCAA Air Pollution Control Officer Gary W. Pruitt. The workgroup is comprised of a representative from the Yakima Valley Dairy Federation, local dairy owners, environmental scientists, an agronomist, two YRCAA board members, YRCAA staff, the Yakama Nation, and the affected public. The workgroup jointly reviewed the issues, problems, alternative solutions and potential standards to contribute to a policy proposed by Mr. Pruitt to the Board.

A draft policy was developed and, although not a rule which requires specific administrative procedures, YRCAA chose to follow the rulemaking procedures, including a public comment period. A draft of the policy was posted on the YRCAA website in November 2010, soliciting public comments for a period of 30 days, thereby giving the public-at-large a responsive voice on the policy elements. Once reviewed and responded to, the public comments were then posted on the YRCAA website. Mr. Pruitt then crafted a final draft which was submitted for Board approval.

On February 10, 2011 the Board approved the policy as a pilot research project aimed at gathering information, testing the feasibility of implementing the policy, and measuring the effectiveness of the policy. Packets were sent to every Yakima County dairy with information about the pilot project and an invitation to attend an informational workshop held on March 15, 2011. During the workshop, YRCAA staff explained the process and presented an example of an Air Quality Management Plan (AQMP) to be submitted by the dairy.

YRCAA recruited and worked with eight producers at fifteen dairy facilities who voluntarily participated in the pilot project, implementing the draft policy over the last ten months. The AQMP was further developed and implemented at each participating dairy and YRCAA staff used the AQMPs that were submitted as a starting point for evaluating BMPs utilized to prevent or reduce air emissions. Two site visits were conducted at each dairy and inspection reports and score sheets, which served as a means to measure the effectiveness of BMPs utilized, were provided to each participating dairy following the site visits. Technical assistance documents were also developed to aid producers in selecting which BMPs to implement.

The pilot study targeted eight air pollutants for each system within a dairy operation. The pollutants were: Ammonia (NH<sub>3</sub>); Nitrous Oxide (N<sub>2</sub>O); Hydrogen Sulfide (H<sub>2</sub>S); Volatile Organic Compounds(VOC); Odor; Particulate Matter (PM); Methane (CH<sub>4</sub>) and Oxides of Nitrogen (NO<sub>x</sub>). The systems were: Nutrition; Feed Management; Housing - Freestall Barns, Housing - Drylot Pens; Grazing; Manure Management; Land Application (Fertilizer and Manure); and Other (those newly identified during the pilot study).

The project work was completed in December, 2011. YRCAA and the project team conducted an effectiveness assessment of the policy, determined modifications necessary, made minor changes and included documents developed during the project. The Executive Director will propose a final policy to the YRCAA Board of Directors, recommending adoption, on February 10, 2012.

### **III. THE WORK**

A scope of work (SOW) document was prepared which defined work to be accomplished during the time period beginning February 10, 2011 and ending December 31, 2011. The SOW also identified the purpose of the project as, “to test the feasibility of a policy designed to provide guidance and establish requirements for effective prevention of air emissions from dairy operations located in the jurisdiction of YRCAA.” The SOW also identified the objectives of the project as to:

1. Assist in the development of Air Quality Management Plans (AQMPs) designed to prevent or reduce air emissions by implementation of Best Management Practices (BMPs);
2. Assure AQMPs and BMPs are effectively implemented;
3. Determine which BMPs are economically feasible; and
4. Furnish a report which states findings, conclusions and recommendations for further policymaking.

## **Project Team**

A project team was assembled to conduct the project work. The project team consisted of YRCAA Staff and scientists from Whatcom Conservation District (WCD) and Washington State University (WSU) as follows:

### YRCAA

Gary W. Pruitt, Air Pollution Control Officer  
Hasan Tahat, Ph.D., Engineering and Planning Division Supervisor  
Keith Hurley, Compliance Division Supervisor  
Mark Edler, Compliance Division Field Agent  
Dave Caprile, Public Information/Education Officer  
Quatandra Jarvis, Engineering and Planning Division Administrative Assistant  
Teresa Coons, Engineer/Planner

### WCD

Nichole Embertson, Ph.D., Nutrient Management and Air Quality Specialist

### WSU

Pius Ndegwa, Ph.D., Associate Professor, Biological Systems Engineering.

## **The Work**

Team members were assigned specific tasks within the scope of the project. The work was accomplished with voluntary participation by dairy operations representing, medium and large dairies. Eight dairies representing fifteen facilities participated in the pilot project. The work was divided into categories and specific team members were assigned primary responsibility for causing the work to be accomplished. The work, assignments and schedule are summarized in Table 1. The work and primary team members were assigned as follows:

### Project Oversight – Pruitt

Oversight for the project was the responsibility of Mr. Pruitt as project manager. Oversight of any specific category of work was delegated to another project team member at the discretion of Mr. Pruitt. Oversight consisted of: assigning work; observing work and reviewing work products; and assuring quality of work, efficacy of work toward meeting the objectives of the project, and efficiency within the budget for the project.

### Send AQMP Templates to Dairies – Tahat

Dr. Tahat prepared and sent a letter introducing the project to all YRCAA dairies, including AQMP and Operational Plan templates. Dr. Tahat was assisted by Ms. Quatandra Jarvis.

### Prepare Compliance Assistance Materials – Pruitt and Tahat

Mr. Pruitt and Dr. Tahat prepared the drafts for the following three compliance assistance documents:

- Descriptions of BMPs – this document describes the BMPs as they apply to individual systems within the dairy to prevent emissions of specific pollutants.

- Selecting BMPs – this document detailed the factors to consider in selecting BMPs. This document evolved into a BMP selection matrix developed by Dr. Ndegwa.
- BMP Score Sheet – this document allowed for scoring the effectiveness of each BMP as it applies to prevention of specific pollutants within each system.

Scientific Review of Compliance Assistance Materials – Drs. Embertson, Ndegwa, and Tahat  
Drs. Embertson, Ndegwa and Tahat reviewed and finalized the above documents.

Conduct Workshops - Caprile

Mr. Caprile organized and facilitated the workshops and kept the public informed on the status of the project.

Provide Individual Assistance – Tahat and Coons

Individual assistance in preparing AQMPs was provided primarily by Ms. Coons and Dr. Tahat.

Receive and Review AQMPs – Tahat and Coons

Dr. Tahat and Ms. Coons received and reviewed AQMPs and obtained additional information when needed.

Conduct Site Visits – Hurley, Edler, Coons, and Embertson

Mr. Hurley oversaw the site visits conducted by Mr. Edler and Ms. Coons. The purpose of the site visits was to verify implementation and the effectiveness of the BMPs listed in the AQMP. Dr. Embertson joined the inspection team on the first round of visits to provide informational assistance.

Compile and Analyze Data – Tahat, Coons

Dr. Tahat and Ms. Coons compiled and analyzed the data gathered from the AQMPs and site visits.

Scientific Review of Data Analysis – Embertson and Ndegwa

Drs. Embertson and Ndegwa reviewed and finalized the data analysis.

Project Report – Pruitt, Tahat, Coons

Dr. Tahat, Ms. Coons and Mr. Pruitt drafted the final report. The report states the findings, conclusions and recommendations for further research and/or policymaking.

WSU Administration – Dr. Ndegwa oversaw the administration of funding from WSU.

**Table 1 - Pilot Project Work**

<b>Work</b>	<b>Staff</b>	<b>Begin</b>	<b>End</b>
Project oversight	GP	02/10/11	12/31/11
Mail out letters and AQMP forms	HT	02/14/11	02/18/11
	TJ		
Prepare compliance assistance documents	GP	02/14/11	02/18/11
Scientific review of compliance assistance documents	NE/PN	02/21/11	02/25/11
Conduct two workshops to assist AQMP preparation	GP	TBD	TBD
	HT		
	DC		
Provide individual assistance in AQMP preparation	HT	02/14/11	12/31/11
Receive and review AQMPs	HT	03/01/11	12/31/11
	TJ		
Site visits to determine BMP implementation	KH	05/01/11	08/31/11
	ME		
	TC		
Follow-up actions from site visits	ME	05/01/11	08/31/11
Data compilation and analysis	HT/TC	06/01/11	09/30/11
Scientific review of data analysis	NE/PN	10/01/11	11/30/11
Prepare draft report	HT	12/01/11	12/09/11
	GP		
Scientific review of draft report	NE/PN	12/12/11	12/30/11
Prepare final report	GP	01/02/12	01/27/12
WSU administration	PN	02/10/11	12/31/11

#### **IV. PARTICIPATION AND SITE VISITS**

In February 2011, packets were sent to every dairy in Yakima County within our jurisdiction with information about the YRCAA Board-approved pilot project and an invitation to participate and attend an informational workshop March 15, 2011. At the workshop Dr. Tahat presented the BMPs aimed at reducing specific air emissions from specific systems. Dr. Ndegwa presented a BMP selection guide, a step-by-step plan to walk operators through selection of the BMPs based on pollutants of concern and their relevant source locations. The meeting provided dairy owners with an opportunity to gain a better understanding of the purpose of the project and what participation would require of them. During the workshop dairy owners also gave some suggestions for changing the AQMP template.

Over the next several weeks eight producers, consisting of fifteen dairy facilities, decided to participate in the project. AQMPs were then submitted by the participating dairies. In the AQMPs, producers examined their operations and considered which BMPs they were already using, and which BMPs they would consider implementing. Several producers also submitted an

overall summary of their operation to give a clearer picture of the process flow. The participating dairies represented approximately 60,000 head of dairy cattle (almost half of the total population of dairy cows in the County) utilizing approximately 11,000 acres.

Dairy site visits were completed in two separate rounds, the first during the dry season between May and June and the second during the wet season in October. The inspection team included a compliance inspector and an engineer from YRCAA accompanied by Dr. Embertson. There were two parts to the site visit, an in-office portion and a facility tour. The in-office portion involved a review of the information submitted in the AQMP, confirming nutrition information, and gaining a broad understanding of the facility nutrient flow: Nutrition → Feed Management → Milk Parlor → Housing (Drylot and/or Freestall) → Manure Management → Land Application.

Facility owners and farm managers led the inspection team step-by-step through the operation, answering numerous questions related to management practices. All BMPs, whether listed in the AQMP or not, were examined. Often BMPs were being implemented in ways similarly but not exactly as described in the list of applicable BMPs. Dr. Embertson joined the inspectors on each of the first-round site visits offering advice about things to look for, how to recognize a BMP, and explaining biochemical reactions and processes related to air pollutant emissions. The inspection team found that it is possible for a BMP to mitigate one pollutant and increase others. For example, watering drylot pens reduces PM, but may increase odor production and ammonia volatilization.

Through the inspections, it was suggested that BMPs for on-farm road management, installation of windbreaks, and internal combustion engine selection and efficiency be added to the list of BMPs. Some of the BMPs listed were altered through the process so that inspectors could more accurately score the systems. Site visit reports were sent to dairy operators with a description of the systems inspected, any major air emissions sources identified, and recommendations of how to reduce the emissions of those sources by improving the current BMPs or implementing new BMPs.

A second round of site visits was conducted by an inspector and an engineer from YRCAA to examine seasonal variations in practices and conditions, as well as confirm effectiveness of pollutant reduction for the BMPs implemented. The inspectors observed the dairies with a fresh perspective, as if it were the first visit. After having developed a sense of what the major issues were during the first inspection, the inspection team was able to look at those areas again with a keener eye. They were more scrupulous of the lagoons and solids separation areas and assessed the feed areas from a practical standpoint (location on farm, shelter, structures, where they mix feed, etc.), asking why the farmer is doing things certain ways (time, labor, money, etc.). This helped the inspectors ask better, more direct questions to obtain the necessary information and offer recommendations from which the farmer could potentially benefit.

Following the site visits, a score sheet was completed for each dairy. Each BMP was assigned a weighting factor for each pollutant, based on its effectiveness at mitigating each pollutant. First-hand observation allowed inspectors to evaluate the level of implementation of BMPs. A score between 0 and 5 was assigned to each pollutant for each BMP being implemented based on its effectiveness at mitigating each air pollutant. Scores were then calculated into a weighted

percentage of air pollution reduction for each pollutant. Scores for each system were also calculated and a total farm score was calculated. The scores demonstrate how effective each BMP is for individual pollutants, individual systems and farm-wide for all BMPs for all pollutants across all systems. The score sheet identifies opportunities for improvement for specific pollutants and systems.

## **V. COMPLIANCE ASSISTANCE DOCUMENTS**

Prior to beginning the project, several documents were developed to assist dairy owners in understanding and complying with the policy. During the project, the documents were refined to better their purpose. Also, to assist YRCAA staff in evaluating the effectiveness of BMPs, and to help dairy owners better understand BMP effectiveness, a score sheet was developed. This section briefly describes those documents. Each document is included in the Appendix of this report.

Two documents listing each BMP known to be effective at mitigating air emissions were prepared and refined during the project. The first document, *Pollutant-Specific Best Management Practices*, (Appendix A) lists BMPs by air pollutant. The second document, *System-Specific Best Management Practices*, (Appendix B) lists BMPs by farm system.

A document entitled *Descriptions of Best Management Practices* (Appendix C) describes each BMP in detail, explaining how each works to mitigate air emissions. Another document, *Dairy BMPs Quick Reference Table*, places the BMPs, sorted by system, into a table. (Appendix D)

In order to evaluate the facilities accurately and effectively, scoring and BMP selection evaluation tools were also developed. A *Tiered BMP Selection Matrix* (Appendix E) was developed to further assist dairy owners in choosing BMPs to implement, once they have identified areas to improve. This document is a step-by-step guide to aid dairy owners in the selection of BMPs based on the pollutants of concern and their relevant source locations. The tiered approach is based on the economic, technical and time investment requirements of each BMP. The Tiered BMP Selection Matrix also provides inspectors with a method to provide recommendations to a dairy, identifying the various tiers and suggesting a dairy start with lower tiered BMPs and move to a higher level until the desired air pollution reduction is reached.

A *BMP Score Sheet* (Appendix F) was developed based on scientific research conducted on the effectiveness of BMPs at reducing air pollution. To be completed for each dairy, the purpose of the score sheet was to give dairy owners and farm managers an idea of how effective each BMP is at mitigating specific air pollutants within each farm system by assigning a score to each BMP.

## **VI. FINDINGS**

The vast majority of recommended BMPs are found to be economically feasible and all are found to be technically feasible. Some BMPs naturally come at a higher cost but using a tiered approach allows for planning improvements to higher-tier BMPs to be incorporated into the farm plan for future implementation.

Dairies are implementing many of the recommended BMPs and some dairies are searching for further solutions to reduce air emissions, even at higher costs. Certain recommended BMPs had already been tested and deemed inappropriate by some dairies. One dairy tried using an additive in their manure storage lagoon to reduce odor but it was found to be fairly ineffective. Another dairy attempted to use an additive in the flush water of a freestall barn to reduce air emissions. The additive disrupted the natural biochemical processes in the lagoon and caused complications in their manure management system.

Of the 15 facilities evaluated, farm-wide BMP scores ranged from 82% to 96%. Some common opportunities for improvement include more frequent removal of manure from dry lot pens, stockpiling manure outside the pen, increasing the frequency of freestall barn flushing, knocking down and removing fence line manure more frequently, and injecting or incorporating manure into the soil within 24 hours of land application. Data gathered from review of Air Quality Management plans and site visits are summarized in the figures found in Appendix G.

Larger dairies are generally implementing higher-tier BMPs, despite the higher costs. Some higher-tier BMPs include highly effective mechanical solids separators, an anaerobic (methane) digester, an automated flush system, and a Variable Rate Technology (VRT) manure application system.

## **VII. CONCLUSIONS**

EPA is reviewing data on emissions from the *National Air Emissions Monitoring Study*, a two-year study of emissions from farms that raise pigs, broiler chickens, and from egg-laying operations and dairies to develop air emissions estimating methodologies, commonly used to estimate emissions from industries where site-specific monitoring data are not available. It will be years before dairy emission estimating methodologies are finalized and more years before EPA sets air emission standards for dairies.

Meanwhile, since it is known that certain management practices mitigate air emissions from dairies, it is reasonable to establish by policy or rule, requirements to implement management practices found to be effective and both economically and technically feasible. Since air emissions from dairy operations are considered to be fugitive emissions (cannot feasibly be collected and passed through a control device), mitigation must be accomplished by prevention rather than control. This policy is intended to implement Chapter 173-400 of the Washington Administrative Code and clarify what constitutes "reasonable precautions to minimize air emissions" from dairy operations. The means to accomplish this is to identify pollutant-specific and system-specific best management practices (BMPs) for minimizing air emissions and to cause these practices to be implemented according to flexible, site-specific Air Quality Management Plans.

The Office of the YRCAA Air Pollution Control Officer concludes the project work has served to accomplish the purpose of the project. That purpose being to test the feasibility of a policy designed to provide guidance and establish requirements for effective prevention of air emissions from dairy operations. Further, the Air Pollution Control Officer finds the following objectives of the project have been accomplished:

1. Assist in the development of Air Quality Management Plans (AQMPs) designed to prevent air emissions by implementation of BMPs;
2. Assure AQMPs and BMPs are effectively implemented; and
3. Determine which BMPs are economically and technically feasible.

Finally, the Air Pollution Control Officer finds that the policy submitted to the YRCAA Board of Directors on February 10, 2011, if fully implemented, will result in significant mitigation of air emissions from dairy operations.

## **VIII. RECOMMENDATIONS**

The Office of the Air Pollution Control Officer recommends the following:

1. Adopt the Air Quality Management Policy and Best Management Practices for Dairy Operations (the Policy);
2. Fully implement the Policy, effective March 1, 2012; and
3. Continue the Dairy Emissions Work Group to test and measure the effectiveness of the Policy.

## **IX. APPENDICES**

### **Appendix A: Pollutant-Specific Best Management Practices**

## **Appendix B: System-Specific Best Management Practices**

## **Appendix C: Descriptions of Best Management Practices**

## **Appendix D: Dairy BMPs Quick Reference Table**

## **Appendix E: Tiered BMP Selection Matrix**

## **Appendix F: BMP Score Sheet**

## **Appendix G: Data Summary**